High Voltage PSU

a universal supply for valve amplifiers

Design by Nils Gohr

This power supply unit (PSU) provides hum-free and stable operating voltages for valve preamplifiers and power stages. Negative bias voltage included!

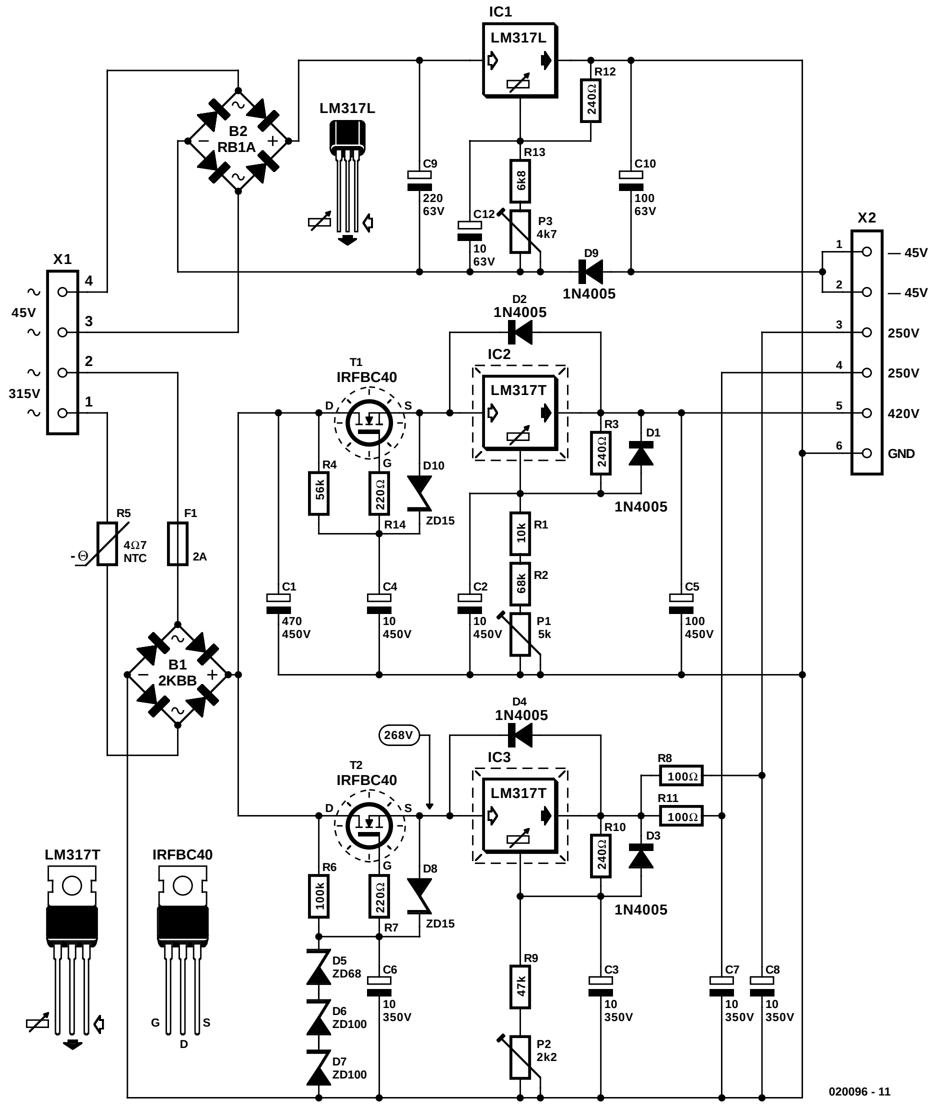


Figure 1. Three voltage regulator for three supply rails typically required in valve power amplifiers.

Editor's note:
The circuit is published as suggestion only. It has not been tested or constructed by Elektor's in-house design laboratory, hence the absence of an Elektor-style PCB layout and a parts list.

Most valve amplifier circuits require a high-voltage power supply. Here, such a circuit is proposed by one of our readers, Mr. Nils Gohr, who claims to own a working prototype.

The concept of the PSU is just fine for a power output stage using KT66 or KT88 power pentodes in push-pull or A/B mode requiring a relatively high plate voltage (here, 420 V) I combination with a grid bias voltage of –45 V for the quiescent current setting.

The preamplifier stage may be built around a double triode with two mutually decoupled 250-V anode voltages being available on the PSU.

Three voltages

The circuit requires a mains transformer with secondary windings supplying 315 volts and 45 volts connected to the circuit via terminal block X1. Each output voltage has its own stabilizer. The resultant three regulators circuits are almost identical and based on the adjustable voltage regulator type LM317. The two high-voltage branches additionally feature soft start circuits based on FETs. These sub-circuits prevent the smoothing (reservoir) capacitors from being damaged by the current surge that occurs at switch on.

The raw direct voltage obtained from the rectifier on the 315-Vac winding is smoothed by C1 and applied to the voltage regulator via the FET. The direct voltage at the regulator input will be approximately 444 V. The target output voltage of 420 V is adjusted with the aid of preset P1 at the 'adjust' input of the IC. The 'adjust' voltage is always 1.2 V below the output voltage. Consequently, series network R1-R2-P1 drops about 420 V. Capacitor C2 is connected in parallel with this network to afford some buffering of the adjust voltage. Diode D1 counteracts the effect of C2 by ensuring that the adjust voltage can become positive with respect to the output voltage buffered by C5. In similar fashion, D2 protects the voltage regulator by preventing the output voltage exceeding the input voltage. All electrolytics in this section of the PSU must be rated at 450 volts!

The soft start is implemented using an R-C network R4-C4. Capacitor C4 will charge relatively slowly via R4, causing the current through the FET to increase proportionally. Diode D10 prevents the source-gate voltage from exceeding 15 volts.

With the exception of diodes D5, D6 and D7, the 250-V stabilisation is identical to the 420-V section discussed above. The three zener diodes keep the gate of FET T2, and with it the input of the voltage regulator, at about 268 V. Because most valve amplifiers have an input stage based on a double triode, two mutually decoupled 250-V rails are available at the output. The decoupling elements are R8-C8 an R11-C7.

Finally, there's a low-voltage section based around regulator IC1, whose task is to furnish a negative bias voltage for the input grid (G1) of the output valves. The current requirement on the output should not exceed a couple of milli-amps. Because the output voltage is to be negative with respect to the PSU and amplifier ground, a separate rectifier is required to enable the enable the regulator output potential to be connected to ground. Preset P3 should be adjusted for a lower reference potential of –45 V. Although the grid bias section of the supply is also based on an LM317, it should be noted that it differs from the two HV sections in that a low-current version in a TO92 case is used.

PCB layout

The other two regulator are housed in a TO220 case and are suitable for an output current of 1.5 A. Because of the anticipated heat dissipation, they should be mounted on heatsinks. The same applies to the FETs in the soft start circuits. On the PB designed by the author, an elegant solution has been found in that the two associated TO220 parts are mounted back to back on PCB-mount heatsinks type SK129 from Fischer (Dau Components). Unfortunately there are unequal potentials at the cooling fins (LM317: output; IRFBC40: drain), so that insulating washers are required.

The PCB layout only just meets the electrical safety requirement for tracks carrying voltages of the order of 400 V and more. The requirement is a track distance of at least 0.9 mm.

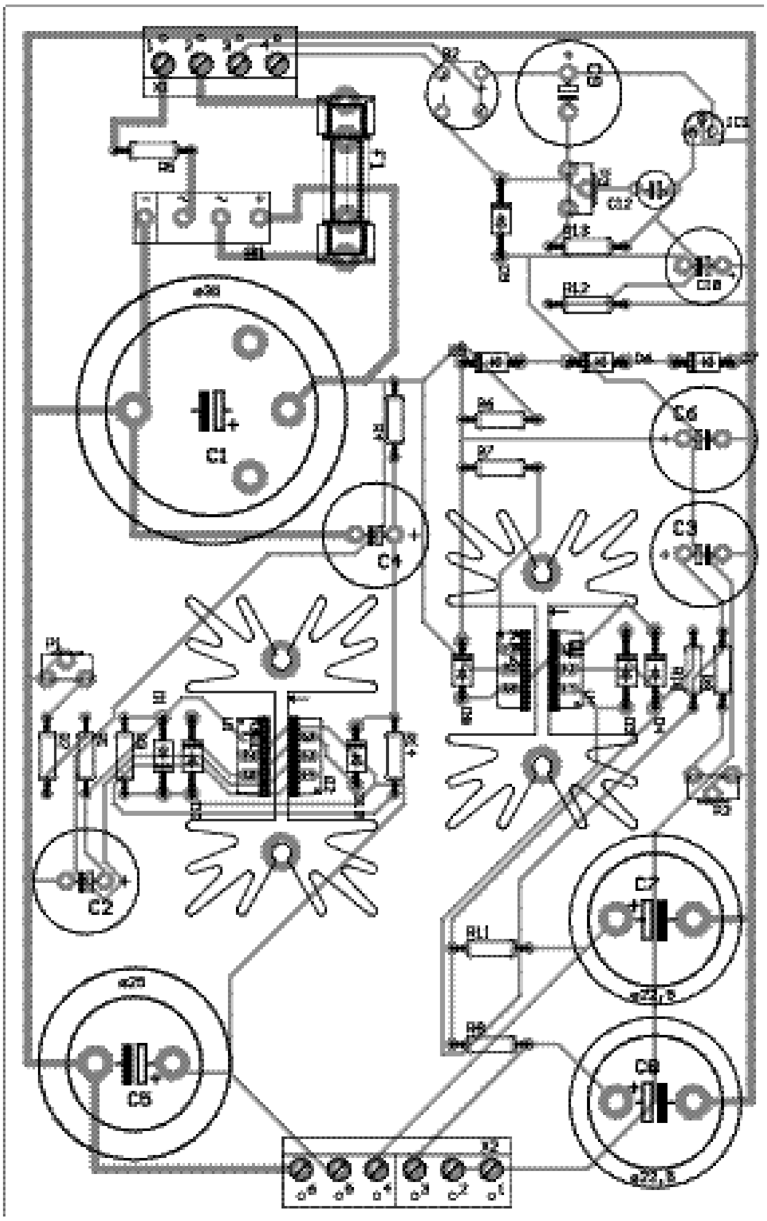
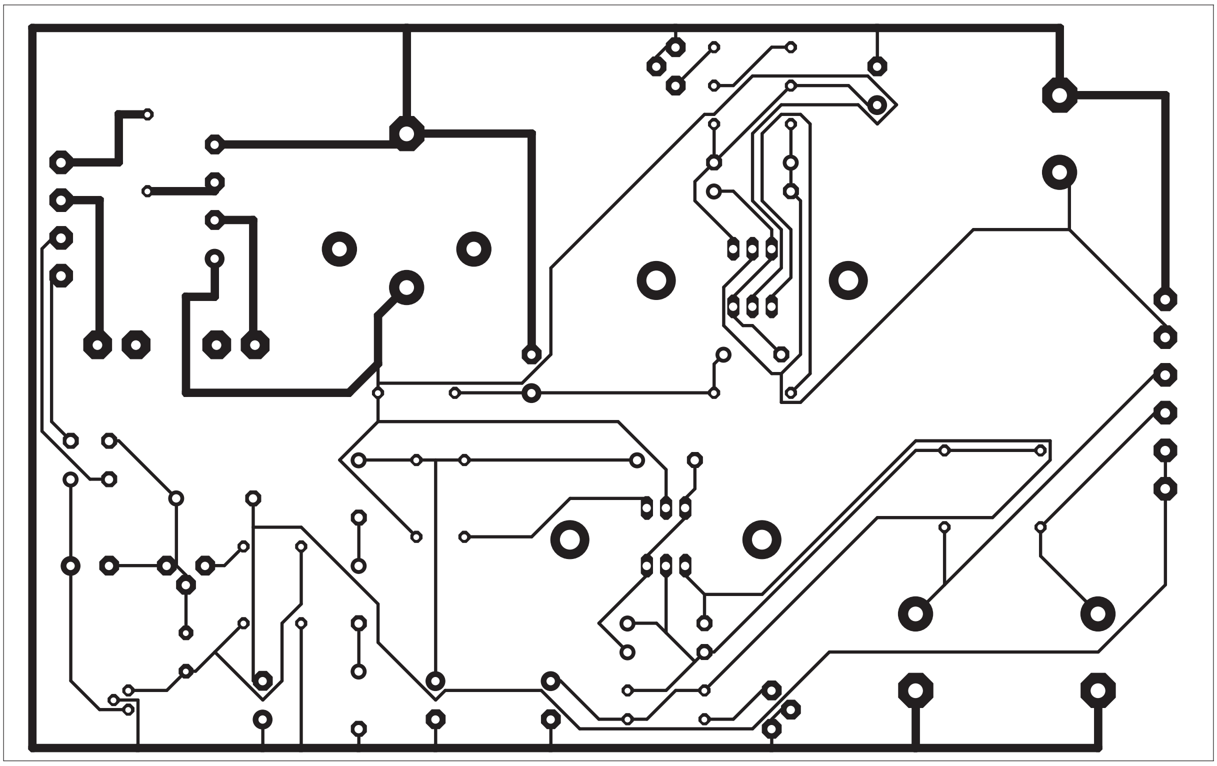


Figure 2. The generously laid out PCB designed by the author (not available ready-made through Readers Services).



Warning

This circuit carries dangerous and potentially lethal voltages and should only be built and used whilst in compliance with relevant electrical safety precautions.

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